Capt. Mangles R.N.
from the Author.

OBSERVATIONS

ON

A CURRENT

THAT OFTEN PREVAILS TO THE WESTWARD OF SCILLY; ENDANGERING THE SAFETY OF SHIPS THAT APPROACH THE BRITISH CHANNEL.

With Additions in 1815. (page 37)

BRITISH MUSEUM

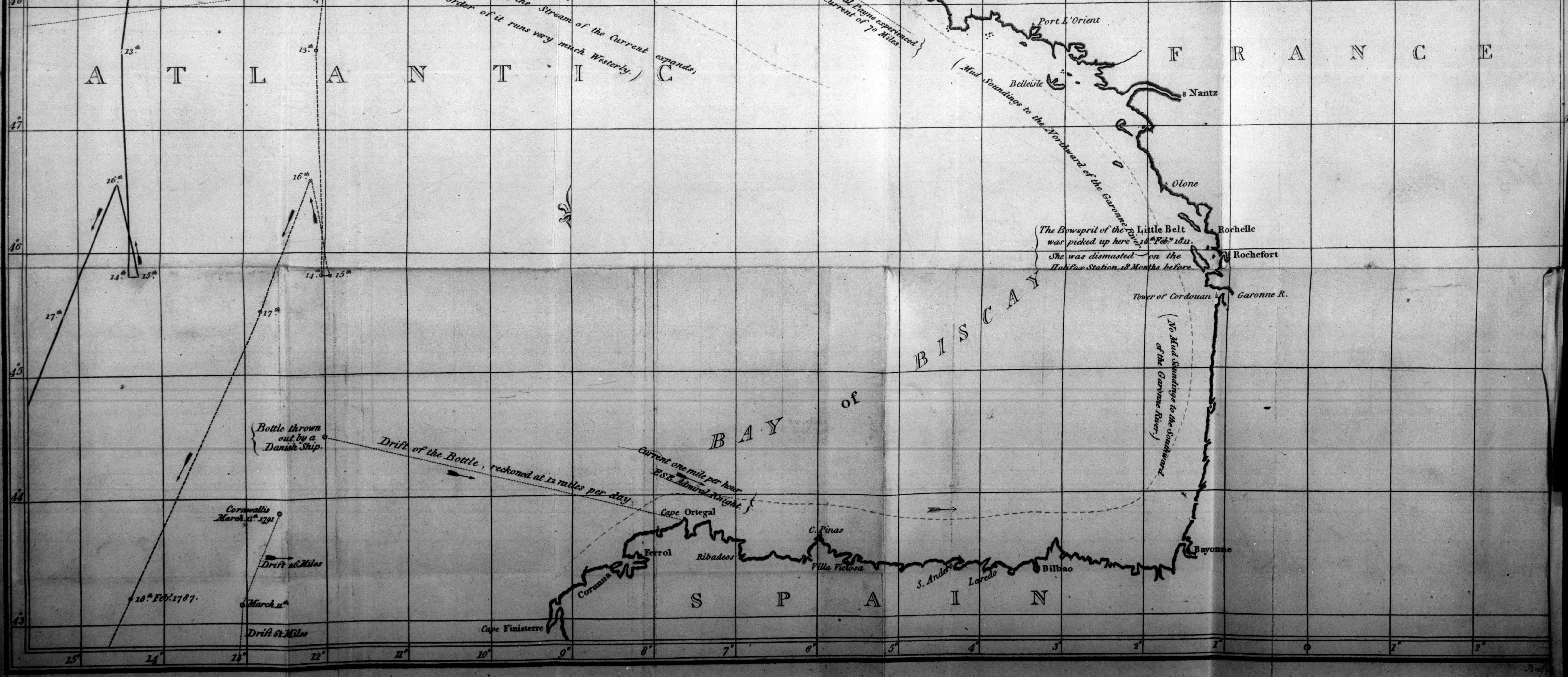
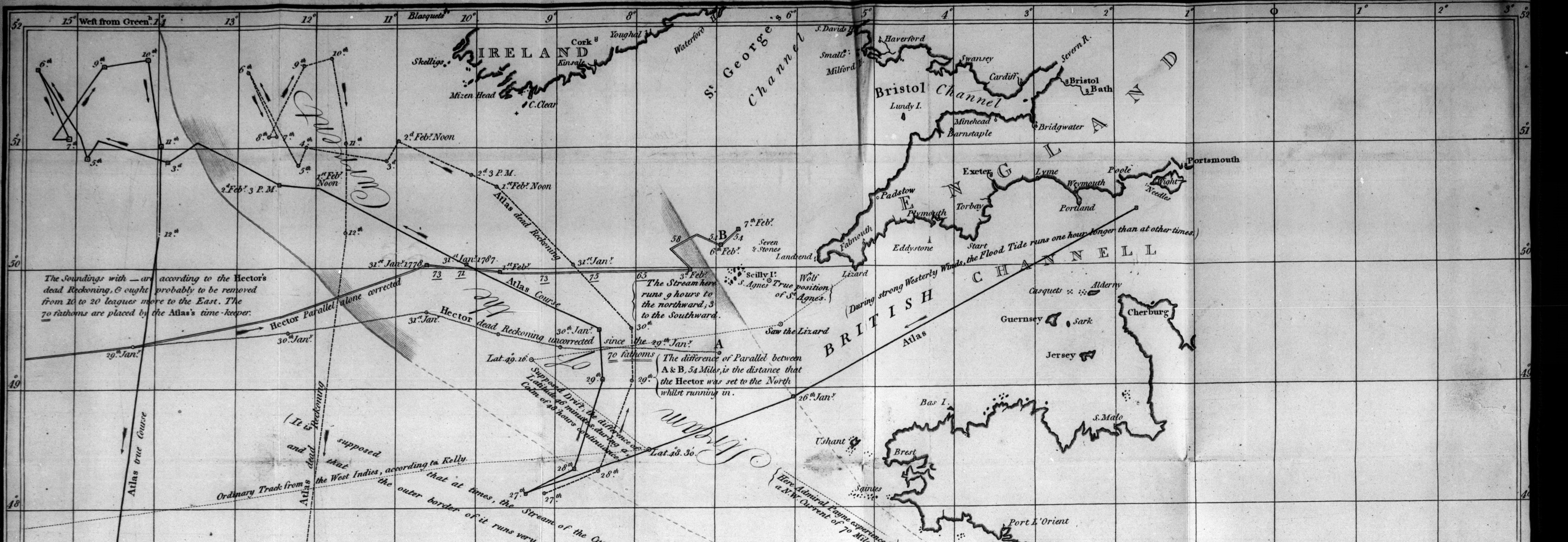

A T L A N T I C
F R A N C E
B A Y of B I S C A Y
S P A I N
Stream of the Current expands,
rder of it runs very much Westerly.
al Payne experienced
Current of 70 Miles
Mud Soundings to the Northward of the Garonne River.
Port L'Orient
Belleisle
Nantz
Olone
Rochelle
Rochefort
The Bowsprit of the Little Belt was picked up here 18th Feby. 1811.
She was dismasted on the Halifax Station 18 Months before.
Tower of Cordouan
Garonne R.
No Mud Soundings to the Southward of the Garonne River.
13th
16th
14th
15th
17th
18th Feby. 1787.
Bottle thrown out by a Danish Ship.
Drift of the Bottle, reckoned at 12 miles per day
Current one mile per hour E.S.E. Admiral Knight.
Cornwallis March 11th 1791
Drift 26 Miles
March 11th
Drift 61 Miles
Cape Ortegal
Ferrol
Ribadeos
C. Pinas
Villa Viciosa
S. Ander
Laredo
Bilbao
Bayonne
Corunna
Cape Finisterre
47°
46°
45°
44°
43°
15°
14°
13°
12°
11°
10°
9°
8°
7°
6°
5°
4°
3°
2°
1°
0
1°
2°

CHART of the *TRACKS* of the HECTOR and ATLAS *EAST INDIA SHIPS*, in 1778 & 1787, Exhibited with a Design to prove the Existence of a CURRENT, between USHANT and IRELAND.

With Additions in 1815.

Philos. Trans. MDCCCXV, *Plate* X. *p.* 20



OBSERVATIONS

ON

A CURRENT

THAT OFTEN PREVAILS TO THE WESTWARD OF SCILLY; ENDANGERING THE SAFETY OF SHIPS THAT APPROACH THE BRITISH CHANNEL.

BY

JAMES RENNELL, Esq. F. R. S.

—K

FROM THE

PHILOSOPHICAL TRANSACTIONS.

THY way is in the sea, and THY path in the great waters, and
THY footsteps are not known. PSALM lxxvii, 19.

LONDON:
PRINTED BY W. BULMER & CO.
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BRITISH MUSEUM

OBSERVATIONS, &c.

Read before the ROYAL SOCIETY, *June* 6, 1793.

IT is a circumstance well known to seamen, that ships, in coming from the Atlantic, and steering a course for the British Channel, in a parallel somewhat to the *south* of the Scilly Islands; do, notwithstanding, often find themselves to the *north* of those islands: or, in other words, in the mouth of the St. George's, or of the Bristol Channel. This extraordinary error has passed for the effects, either of bad steerage, bad observations of latitude, or the indraught of the Bristol channel: but none of these account for it satisfactorily; because, admitting that at times there may be an indraught, it cannot be supposed to extend to Scilly; and the case has happened in weather the most favourable for navigating, and for taking observations. The consequences of this deviation from the intended track, have very often been fatal: particularly in the loss of the Nancy packet, in our own times; and that of Sir CLOUDESLEY SHOVEL, and others of his fleet, at the beginning of the present century. Numbers of cases, equally melancholy, but of less celebrity, have occurred; and many others, in which the danger has been imminent, but not fatal, have scarcely reached the public ear. All of these have been referred to accident; and therefore no attempt seems to have been made, to investigate the cause of them.

I am however of opinion, that they may be imputed to a specific cause; namely, a current: and I shall therefore endeavour to investigate both that, and its effects; that seamen may be apprized of the times, when they are particularly to expect it, in any considerable degree of strength; for then only, it is likely to occasion mischief; the current that prevails at ordinary times, being, probably, too weak to produce an error in the reckoning, equal to the difference of parallel, between the south part of Scilly, and the track that a commander, prudent in his measures, but unsuspicious of a current, would choose to sail in.*

It seems to be generally allowed, that there is always a current, setting round the Capes of Finisterre, and Ortegal, into the Bay of Biscay. This I have the authority of Captain MENDOZA RIOS, a Fellow of the Royal Society, and an officer in the royal navy of Spain, for asserting. Besides, such an intimation was amongst the earliest notices that I received, concerning matters of navigation, when on board of a ship that sailed close along the north coast of Spain, in 1757. The current then, is admitted to set to the eastward, along the coast of Spain; and continues its course, as I am assured, along the coast of France, to the north, * and north-west: and indeed any body of water, once set in motion, along a coast, cannot suddenly stop; nor does it, probably, lose that motion, until by degrees it mixes with the ocean; after being projected into it, either from the side of some promontory, that extends very far beyond the general direction of the coast; or after being conducted into it, through a strait.

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* It may be remarked, by the way, that the true latitude of the present light-house on St. Agnes's Island, is 49°, 54′; and that of the most southerly part of the whole group of islands and rocks, is 49°, 52′. This is according to an advertisement given out by the Trinity House, in 1792.

The original cause of this current, I apprehend to be, the prevalence of westerly winds in the Atlantic; which, impelling the waters along the north coast of Spain, occasions a current, in the first instance. The stronger the wind, the more water will be driven into the Bay of Biscay, in a given time; and the longer the continuance of the wind, the farther will the vein of current extend.

It seems to be clearly proved, that cur-

* Since proved by Capt. W. King R.N. Feb. 1797.

rents of water, after running along a coast that suddenly changes its direction, (as happens on the French coast, at the promontory south of Brest) do not change their course with that of the shore, but preserve, for a considerable time, the direction which they received from the coast they last ran by. In some instances, after being projected into the sea, they *never* again approach the shore; but preserve, to a very great distance, nearly the direction in which they were projected; as well as a considerable degree of their original velocity, and temperature. The gulf stream (of Florida) is a wonderful instance of this kind; which, originating in a body of *pent-up* waters, in the Gulf of Mexico, is discharged with such velocity, through the Straits of Bahama, that its motion is traceable through the Atlantic, to the Bank of Newfoundland; and may possibly extend much farther.* † This being therefore the case, we can have no difficulty in conceiving that the current of the Bay of Biscay continues its course, which may be about NW by W, from the coast of France, to the westward of Scilly and Ireland.

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* See Sir Charles Blagden's Observations on the Heat of the Gulf Stream, in the Philosophical Transactions, Vol. LXXI. page 334.

† It is now well known to extend *ordinarily* to the Azores; & at *certain times* to the coasts of Europe.

At ordinary times, its strength may not be great enough to preserve its line of direction, across the mouth of the British Channel; or, if it does preserve its direction, it may not have velocity enough to throw a ship so far out of her course, as to put her in danger. But, that a current prevails *generally*, there can be little doubt; and its degree of strength will be regulated by the state of the winds. After a long interval of moderate westerly gales, it may be hardly perceptible; for a very few miles of northing, in the 24 hours, will be referred to bad steerage, or some other kind of error: but after hard and continued gales from the western quarter, the current will be felt in a considerable degree of strength; and not only in the parallel of Scilly, but in that of the south-west coast of Ireland likewise.

Our observation of what passes in the most common waters, is sufficient to shew how easily a current may be induced, by the action of the wind, on the water contiguous to a bank, when the wind blows *along* it. In a canal of about four miles in length, the water was kept up *four inches* higher at one end, than at the other, by the mere action of the wind, along the canal. This was an experiment made, and reported to me, by my much lamented acquaintance, the late Mr. SMEATON. We know also, the effects of a strong south-west, or north-west wind, on our own coasts: namely, that of raising very high tides in the British Channel, or in the Thames, and on the eastern coasts; as those winds respectively blow: because the water that is accumulated, cannot escape quick enough, by the Strait of Dover, to allow of the level being preserved. Also, that the Baltic is kept up *two feet* at least, by a strong NW wind of any continuance:

and that the Caspian Sea is higher by *several* feet, at either end, as a strong northerly, or southerly, wind prevails. Therefore, as water pent up, in a situation from which it *cannot escape*, acquires a higher level, so, in a place where it *can escape*, the same operation produces a current: and this current will extend to a greater or less distance, according to the force with which it is set in motion; or, in other words, according to the height at which it is kept up, by the wind.

It may possibly be asked, why a similar current does not prevail in the British Channel, from the same westerly winds? To this I answer, that the increased height and velocity of the tides, during the prevalence of such winds, prove that a part, at least, of the same effect which happens in the Bay of Biscay, is produced in the Channel; and I have little doubt, that there is, in fact, a current also; but that, as it is blended with the common tide, the effect on the senses is lost: for it may appear only in the form of a *stronger* flood tide, or a *weaker* ebb, than at other times. Whereas the Bay, a wider space, and of a different form, allows a freer scope to the tides, than the British Channel does: it being high water nearly at the same time, all over the Bay ; but varying in the Channel, at least five hours. And it may be concluded, from analogy, that the form of the Channel does not allow of the same effect being produced by the wind, on its included waters, as may be produced on those of the Bay: these meeting with an opposition, in the coast of France, the others having a partial exit, at the Strait of Dover : we may also conclude, that if no such phænomenon as a tide existed, a current, though less strong than in the Bay, would be perceived in the British Channel.

Of the Bay of Biscay it may be observed that, by reason of its form, and exposure to the reigning winds, which are often violent, and which pass over a vast expanse of water, there is no part of the ocean, familiarly known to us, whose circumstances are, in any degree, similar to it. It ought not therefore to surprize us, if we find that it differs, in any particular, from other seas. Seamen have remarked its uncommon degree of agitation, in stormy weather; but this has not, as far as I know, been properly accounted for. May it not be owing generally, to the same cause as that which produces the current? and at times, to the very current itself? With respect to the first—the waves of a deep bay or gulf, when the wind forces the water into it, will meet with a resistance in the land at the head of it, which must occasion a reverberation, that will render the surface of a great part of the gulf more unquiet, than when there is an opening at the end, to allow the undulatory motion a freer scope. What is said here, is exemplified on a small scale, by Mr. SMEATON's very ingenious manner of quieting Ramsgate harbour. (See his Tract on that harbour, page 45.) And with respect to the second cause—the effect of a current running to windward, in producing a short, hollow, and therefore dangerous, wave, is pretty well known. Accordingly, at seasons when the current runs strong, and the wind blows fresh from the north-west quarter, this cause must also contribute to the agitation of the waters, in the north part of the Bay.*

It is quite uncertain at what interval of time, from the commencement of strong westerly gales, in the Atlantic and Bay of Biscay, the current may operate on the tracks of ships, near Scilly; for we are not possessed of the *data*, requisite for determining it. If we were to conceive a current, originating on the coast of Spain, and afterwards disturbing the courses of ships, on the west of Scilly and Ireland; this would require too much time, to agree with one of the instances which I mean to adduce: although it is probable, that this may be nearly the effect at ordinary times, and when the westerly winds blow moderately. But as, in one striking instance, it appears that the current operated in a very remarkable manner, on the ship's course, on the fourth day after the commencement of the gale, in the quarter where the ship was; the cause should rather be looked for, in the *sudden* and *great accumulation* of water, in the Bay of Biscay: otherwise there is no accounting for the sudden appearance of the current. And the very act of accumulation, causing an indraught, there will consequently be a current round the Capes of Finisterre, and Ortegal, towards the Bay. Be the exact cause, however, what it may, it no doubt originates in the Bay, by the action of strong westerly winds: the prevalence of such winds, will therefore be the *signal* for the appearance of a current, between Ushant, and the south-west coast of Ireland: for though the cause can only be guessed at, the effect is too well ascertained, to remain in doubt.

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* How far the reverberatory motion may extend, I know not: but it is certain that an undulatory motion impressed on the sea by the wind, will extend to a prodigious distance; and even into a region where a different wind prevails: as for instance, a swell raised by a strong gale, at south, or south-west in the track of variable winds, has been felt, very far within the limits of the south-east trade wind, in the Indian Ocean.

I shall now adduce the facts, on which the idea of the existence of a current is founded.

In crossing the eastern part of the Atlantic, in the Hector East-India ship, Captain WILLIAMS, in 1778, we encountered, between the parallels of 42 and 49, very strong westerly gales; but particularly between the 16th and 24th of January, when, at intervals, it blew with uncommon violence. It varied two, or more points, both to the north and south of west, but blew longest from the northern points; and it extended, as I afterwards learnt, from the coast of Nova Scotia, to that of Spain.

We arrived within 60 or 70 leagues of the meridian of Scilly, on the 30th of January, keeping between the parallels of 49 and 50; and about this time we began to feel a current, which set the ship to the north of her intended parallel, by near half a degree, in the interval between two observations of latitude; that is, in two days. And the wind, ever afterwards, inclining to the south, would not permit us to regain the parallel; for, although the northern *set* was trifling, from the 31st until we arrived very near Scilly; yet the wind, being both *scant* and *light*, we could never overcome the tendency of the current. Add to this, that the direction of the current, being much more *westerly* than *northerly*, we crossed it on so very oblique a course, that we continued in it a long time; and were driven, as it appears, near 30 leagues to the west, by it: for we had soundings in 73 fathoms, in the latitude of Scilly, and afterwards ran 150 miles, by the log, directly east, before we came the length of the islands. In effect, in running 120 miles, we shallowed the water, only nine fathoms.

We not only were sensible of the current, by the observations of latitude, but by *riplings* on the surface of the water, and by the direction of the lead line. The consequence of all this was, that we were driven to the north of Scilly; and were barely able to lay a course through the passage between those islands and the Land's End.

Having no time keeper on board, we were unable to ascertain the several points, in this part of our track, and therefore can only approximate our longitude; and that but very coarsely. But according to what we learnt from our soundings, and from a vessel which had only just entered the current, it may be concluded, that the current, at times, extends to 60 leagues, west of Scilly; and also runs close on the west of those islands. However, the breadth of the stream, may probably be little more than 30 leagues; for we crossed it, as has been said, very obliquely; and perhaps, in the widest part.

The journal of the Atlas East-India ship, Captain Cooper, in 1787, furnishes much clearer proofs, both of the existence of the current, and of the rate of its motion: for having time keepers on board, Captain

Cooper was frequently enabled to note the difference between the true, and the supposed, longitude; and it may be said, that this journal, by the means it affords of ascertaining the current, is highly valuable; as containing some very important facts, and which might have been entirely lost to the public, had not Captain Cooper marked them, in the most pointed manner.

I shall proceed to state, in abstract, the most important of the facts recorded in the journal.

The Atlas sailed with a fair wind, and took her departure from the Isle of Wight, on the 25th of January, 1787; and on the 27th had advanced 55 leagues to the westward of Ushant; when a violent gale of wind began at south, and, about 11 hours afterwards, changed suddenly to the westward. The gale continued through the four following days; on the 28th, it was generally W by S, and W S W; on the 29th, S W by W, or more southerly; and on the 30th and 31st, SSW, to SW by S.*

During this long interval, the ship was generally *lying to*; and with her head to the NW. On the 1st of February, the wind abated, but still blew from the south-westward; and the ship was kept to the north-west. The stormy weather returned again the following day, and continued, with little intermission, until the 11th; blowing from all the intermediate points, between south and WNW; but chiefly, and most violently, from the WSW, and SW. At intervals, on the 8th and 9th in particular, the journal remarks, that "*it blew a mere hurricane*." On the 11th, the weather growing more moderate, and the wind favourable, the ship proceeded on her course, southward; being then two degrees and a quarter of longitude, to the west of Cape Finisterre, by the reckoning; but by the time keepers, more than *four degrees and a half.*

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* In this, as well as in the former statement of the winds, I have allowed for the variation of the compass; that the application of it, to the quarter of the heavens, and to the chart annexed, may be more easy and clear.

After the above abstract of the proceedings of the ship, I shall subjoin the following particulars; which are the most in point, to the purpose of the present discussion.

On the 27th, at noon, soon after the gale commenced, the longitude, by reckoning, agreed within 14 minutes of that shewn by the time keepers; the latter being the most westerly. This difference alone might well have arisen from an error in the log, or even in the position of the needle point on the isle of Wight, from whence the departure was taken; but it may also be owing to the westerly current, whilst the ship remained in it, on the 27th; if we admit that such a current prevails at all times, though in different degrees of strength. Here it is proper to remark, that in delineating Captain COOPER's track, on the chart, I have scrupulously adhered to the result of each day's work, of the reckoning, as I find it in his journal; contenting myself with inserting my own observations on the track, in this paper only; where they cannot mislead.

The longitudes pointed out by the time keepers on the 28th, 29th, and 30th, shew, that the increasing, though trifling differences, between the true longitude, and that by the dead reckoning, had amounted to 24 minutes only, on the 30th. At this time the ship was about 24 leagues to the WSW of Scilly; and, at 5 or 6 leagues to the SSE of this position, (that is, at 25 leagues SW by W from Scilly) they had soundings at 70 fathoms. This last particular is mentioned, to prove that the longitude shewn by the time keepers (8° 28′ west from London) was nearly the longitude in which the ship really was, on the 30th of January. That of St. Agnes (Scilly) is taken at 6° 46′.

The Atlas was now entered into the stream of the same current which occasioned so much delay to the Hector; but the course of the Atlas, being opposite to that of the Hector, it facilitated her progress; and also carried her clear of the south-west coast of Ireland.

On the 31st, the time keepers shewed that the ship had been *set* very considerably to the westward of the reckoning; and by the 2d of February, at 3 in the afternoon, it appeared that she had been *set* two whole degrees of longitude to the west of the reckoning, since the 30th at noon; that is, in the course of 51 hours. (Here it may be proper to remark, that I have, throughout, reckoned according to *sea time*; that is, the day commences at noon.)

On the 3d of February, at noon, the time keepers shewed a further *set*, of 23 minutes of longitude, more than the reckoning gave, in the interval since the last observation, which was 45 hours; so that, since the 30th of January, 4 days only, the ship had been carried by the current, no less than two degrees and twenty-three minutes; and since the 27th, when the gale began, 2° 32′ of longitude; amounting, in these parallels, to ninety-nine marine miles.

But here, the current appears to have totally left them; and it it is very probable, that it even ceased before the time of observation, on the 3d: for the succeeding observations of the 5th, 6th, 7th, 9th, 10th, and 11th, although the strong westerly gales continued, come so near the longitude by the reckoning (deduced from the observation of the 3d) that the differences, which are sometimes to the east, and at other times to the west, may be with more propriety ascribed to the errors of the log, than to a current; as may be seen by the two tracks on the chart. We may therefore conclude, that the current did not cease at the very point of time, when the observation of the 3d was taken, but probably some time before.

It appears then, that the Atlas experienced a westerly current, from a point about 24 leagues to the WSW of Scilly, (if not earlier) to four degrees of longitude west of the meridian of Cape Clear,* in the parallel of 51°; where its effects were no longer perceptible. And, as no current was felt in the track southward, on the 11th; nor in any part of the track to the north-west, between the 3d and 10th; although it was felt nearly in the same line of direction, between the 1st and 3d; it may be inferred that the stream goes off to the north-west, between the aforesaid track, and the south-west coast of Ireland. It is much to be regretted that no observations appear on the 12th and 13th; which would have been decisive of its course.

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* Cape Clear is reckoned to be in long. 9° 15′ from London.

I come now to two particulars of the case, which, I confess, perplex me exceedingly. The first is, that the current was felt, apparently in its full strength, on the fourth day after the commencement of the gale; which began at south, then changed suddenly to the west and WSW, and afterwards fixed in the SW quarter. This gale was felt between the 48th and 50th degrees of latitude, and, no doubt, extended its effects very far to the south and west; but what the state of the winds had been n those quarters, previous to the 27th of January, we are ignorant. The winds in the British Channel had been easterly, for three days preceding the gale: the fourth day preceding, there had been strong gales at SW; and the five days preceding *that*, there had been chiefly light winds at west. According to this state of facts, we can only suppose that the current originated from a vast body of water, pent up in the Bay of Biscay, by violent gales of wind ; first from the southward, eleven hours ; then from a point or two to the south of west ; and lastly, at south-west. We are not to consider the water of this current, as having made the circuit of the Bay of Biscay; but as the *collective body* of *pent-up* waters, in the Bay, running off along the SW coast of Britanny, and thence to the north-westward ; preserving nearly the direction it had acquired, by running along that coast. And it may be conceived, that the frequent recurrence of westerly winds, keeps up a constant current in the Bay, and to some distance beyond it; although during the longest intermissions of these winds, the current may become so slow, as to be scarce perceptible.

The second particular which perplexes me, is, that no northern *set* is indicated by Captain COOPER's journal: that is to say, by the mode in which each day's log is wrought; and which, in the formation of the chart, as is said before, I have strictly adhered to. It indeed appears to me very wonderful, that no northing should appear, when it seems to be the very same kind of current which carried the Hector so far to the northward. It is certain, that the state of the weather was such, as to preclude those nice attentions to the reckoning, which might enable us to detect any small differences, between the latitude by account, and that by observation: although the western *set* was too considerable to escape notice, and may even have been more than the statement sets forth. I cannot therefore, by any means admit, that there was no northing in the current through which the

Atlas passed; first, because they had not observations of latitude, regularly; and lastly, because on the 31st of January, when *lying to*, 36 miles are allowed for 20 hours *drift*, to the north-west; which appears to me excessive. On that day they had no observation of latitude, and on the following day, the observation shewed two miles northing; which however proves nothing. Again, on the succeeding day, (the 2d) in a most important point of the track, there was no observation of latitude.

In the Hector, precisely in the same track, and at the same season of the year, the current had, as has been observed, a considerable degree of northing in its course. On two days it was about 12 miles, each; on another day 13, and on two others, 9, and 8; and this, in weather very favourable for keeping a reckoning, and with observations of latitude, on every day save one; not to mention the strong circumstances of a visible *set* to the northward, indicated, as well by the lead line, as by the ripling on the surface of the water. It is in the nature of currents, to expand their streams or columns of water, after being projected into the ocean; and therefore, according to this law, the middle part of the stream should preserve its original course, in a greater degree than the borders of it; so that the middle part may run to the NW by W, whilst the eastern border may run more *northerly*, and the western border more *westerly*. It is certain, that in the Hector, we felt the northerly current much stronger, close on the west of Scilly, than further out; and it appeared by the distance we ran, after sounding in 73 fathoms, that the current must have set much more *westerly*, than *northerly*, the whole time. *

The following remarks obviously occur, on the effect of this current.

1st. Whatever may be the breadth of the stream, (which is at present unknown) if a ship crosses it *very obliquely*, that is, in an E by S, or more southerly direction (as may easily happen, on finding herself too far to the northward, at the first place of observation, after she gets into the current), she will, of course, continue much longer in it, and will be more affected by it, than if she steered more directly across it. She will be in a similar situation, if she crosses it with light winds; and both of these circumstances should be attended to. And if it be true, as I suspect it is, that the eastern border of the current has a more northerly direction than the middle of it, this also should be guarded against. I conceive also, that the stream is broader in the parallel of Scilly, than farther south. And here we may remark, that those who, from a parallel south of Scilly, have been carried clear of it to the north, when approaching it in the night, may esteem themselves fortunate that the current was *so strong*; for had it been weaker, they might have been carried on the rocks.

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* It has since been discovered, that this Current has a rotatory motion; falling again into the Easterly Current which enters the Bay, by Cape Finisterre; so that the northern part will set to the NW & WNW, the other parts to the W. SW. & S.

2d. A good observation of latitude, at noon, would be thought a sufficient warrant for running eastward, during *a long night*:

yet as it may be possible to remain in the current, long enough to be carried from a parallel that may be deemed a very safe one, to that of the rocks of Scilly, in the course of such a night; it would appear prudent, after experiencing a continuance of strong westerly gales in the Atlantic, and approaching the Channel with light southerly winds, either to make Ushant, or at all events to keep in the parallel of 48°, 45′, at the highest. If they keep in 49°, 30′, they will experience the whole effect of the current, in a position where they can least remedy the evil: but if in 48°, 45′, they are assailed by the north-west current, they are still in a position from whence a southerly wind will carry them into the Channel. But all ships that cross the Atlantic, and are bound to the eastward of the Lizard, had better to make Ushant, under the above circumstances, in times of peace. Or, at all events, why should they run in a parallel, in which they are likely to lose ground?

3d. Ships, bound to the westward, from

the mouth of the Channel, with the wind in the south-west quarter, so that it may appear indifferent which tack they go on, should prefer the *larboard* tack ; as they will then have the benefit of the current.

4th. I understand that the light-house of Scilly is either removed, or to be removed, to the south-west part of the islands ; or of the high rocks. This is certainly a wise measure ; as the light should be calculated more particularly for ships that have a *long*, than a *short* departure ; like those from any part of the European coasts, to the northward, or eastward. The light-house ought also to be built very lofty. I am sorry to remark, that, as far as my observation has gone, this light has never appeared clear and bright, as a light to direct ships ought to do.

5th. It would be worth the attention of government (in my humble opinion) to send a vessel with time keepers on board, in order to examine and note the soundings between the parallels of Scilly and Ushant, at least; from the meridian of the Lizard point, as far west as the moderate depths extend: I mean such as can be ascertained with exactness, in the ordinary method of sounding. I have reason to suppose that our chart of soundings is very bad; and indeed, how can it be otherwise, considering the imperfect state of the art of marine surveying, at the time when it was made? A set of time keepers will effect more, in the course of a summer, in the hands of a skilful practitioner, than all the science of Dr. HALLEY, during a long life; for who could place a single cast of soundings, in the open sea, without the aid of a time keeper? The current in question, must have disturbed every operation of this kind. It should be the task of the person so employed, to note all the varieties of bottom, as well as the depths; the time of high and low water; setting of the tides, and currents, &c. Such a survey, skilfully conducted, might enable mariners to supply the want of observations of latitude, and of longitude; and, of course, to defy the current, as far as relates to its power of misleading them.

6th. It is certain, that the current in question may be somewhat disturbed by, or rather will appear to be blended with, the tides, at the entrances of the British and St. George's Channels; but it is obvious that the current will have the same effect, in setting a ship out of her course, as if no tide existed; because, whatever effect one tide may have, the next will nearly do away. But there are two particulars, well worth ascertaining; and these are, first, the point at which the two tides of St. George's, and of the British Channel separate, on the west of Scilly. And secondly, what degree of northing one of the streams has, more than the other. Because a ship, in approaching Scilly, from the west, on a flood tide, and keeping in a parallel which may be to the *north* of the point of separation of the two tides, (and consequently in the tide stream of St. George's Channel) may be thrown too far to the north; although, had she been far enough to the west, to receive the effect of the next ebb, this temporary, and alternate derangement of the course, would have had no ill effect; or even have been noticed. But admitting that a tide, with any degree of northing in it, does take place, a little to the west of Scilly: this will furnish an additional reason for keeping in a southern parallel.

THE END.

SOME

FARTHER OBSERVATIONS

ON

THE CURRENT

THAT OFTEN PREVAILS TO THE WESTWARD OF THE
SCILLY ISLANDS.

1815.

SOME FARTHER OBSERVATIONS.

Read before the ROYAL SOCIETY, *April* 13*th*, 1815.

DURING the interval of 21 years, since the Society did me the honour to receive my Observations on the Current to the Westward of Scilly, more facts relating to that current, have been collected; as well as observations on its effects, in different parts of its course, between Cape Finisterre and Scilly: the whole tending to a confirmation of the general system set forth, in 1793; and, in one instance, affording, perhaps, a clearer proof of the strength of the stream, in respect of its *northerly* direction, than any of those, adduced on the former occasion.

In pursuing the detail of these facts and observations, I shall begin, in the neighbourhood of Cape Finisterre, and proceed with the course of the current, along the Bay of Biscay; and thence, across the mouth of the British Channel, to Scilly, and the entrance of St. George's Channel.

The three first facts, regard the current from the open sea, setting into the south side of the Bay of Biscay, and along the north coast of Spain; which current has been supposed, in the former Paper, to be occasioned by the prevalent westerly winds; which force the water near the shore, *into the Bay*, and along the southern coast of it. The water so displaced, would be followed of course, by the adjacent water *behind* it, in the open sea; and so on, successively, to a certain extent. This cause, and not the effect of the *Gulf Stream*, extended to the coasts of Europe, as some have supposed, must surely be referred to, as the origin of the Scilly current.

I. The first case, is that of the Earl Cornwallis East India ship. The circumstance occurred on her outward passage: she was well provided with time keepers, as most of the India ships are.

On the 12th March, 1791, between the parallels of 43° and 44°; and at 3° 45′ of longitude, west of Cape Finisterre, (about 53 leagues), this ship experienced an easterly current, equal to 26 marine miles. Her position being directly opposite to the line of the southern coast of the Bay of Biscay, it is a fair conclusion, that the current was occasioned by the cause abovementioned; or as seamen call it, the *indraught* of the Bay: which, it appears, extends to, at least, 53 leagues from the shore. And as the rate, in this place, exceeds one mile *per* hour, it may be supposed, that the effect extends to a still greater distance.

It may here be remarked, that the same ship, in coming out of the *Chops* of the Channel, a few days before, was *set* twenty four miles to the westward, 15 to the northward; in the course of the 24 hours: that is, 28 miles, in a direction of N. W. by W.

This may be supposed to be the same stream of current, in its course from the *Bay* towards *Scilly*.

II. The second fact, is that of the *drift of a bottle*, which was thrown out of a Danish ship, (I believe, sent on discovery) since the publication of the former Paper.

The bottle was thrown out, in lat. 44½°, lon. 12° west from Greenwich: that is, about 48 miles to the N. E. of the Cornwallis's station, at the time that she began to feel the current, on the 11th March. It was taken up by a centinel on duty, near Cape Ortegal; and, as was supposed, at the moment of its driving into the surf. If this was really the fact, the bottle, according to the date of the letter contained in it, must have been carried, at the rate of half a mile *per* hour, in the direction of about E. b. S. ½ S.; the distance was about 64 leagues.

The report of this circumstance was transmitted by the French consul at Corunna, to the Academy of Sciences at Paris.

It may be observed, that the drift of the bottle was much to the *south* of east; whereas, that of the Cornwallis, was east: that is, both pointed towards Cape Ortegal, or its vicinity; as if the main stream of the current, was concentrated there.*

With respect to the velocity of the current, in the present case, all, of course, depends on the time of the arrival of the bottle at the shore. It might have been thrown up long before it was seen, and washed off again, by the tide, or surge of the sea. The *direction*, the most important point, cannot be questioned.

III. The third fact is very simple, and perfectly conclusive. Off Cape Ortegal, at a considerable offing, Admiral Knight found the current, at the rate of one mile *per* hour, setting to the E. S. E.; that is, nearly *along-shore.*

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* It is observed, that, in the mouth of the Strait of Gibraltar, between C. St. Vincent and C. Cantin, the currents point in all directions, between SE. and NE. towards the entrance of the Strait, which may be considered as the pipe of a funnel.

The reader will immediately perceive that these three facts, converge, as it were, to one point: that is, in the proof, that the waters of the Atlantic flow into the Bay of Biscay, along the north coast of Spain.

It would seem that the north-westerly current, by Scilly, did not, at least in many cases, balance the easterly current round Cape Ortegal, and the land of Finisterre.* The loss of His Majesty's frigate, Apollo, with most of her convoy, may surely be attributed to the operation of this current. Captain (afterwards Commissioner) WALLIS, assured me, that after having made, as he supposed, ample allowance for clearing Finisterre, yet, in the night, he had a very narrow escape from shipwreck. Very many others have been brought into the same kind of danger: so that the land of

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* Nor, admitting an equal rate, in both places, could it well be. For the current enters the Bay of Biscay, in an *east* direction, but goes off from it, *north-west*. So that, if a ship was carried fifty miles to the NW. from Ushant, she would only have made about thirty-five westing: but in the other case, she would be carried the *whole* fifty, eastward towards the Bay, and Cape *Finisterre*.

Finisterre, were it not discernible at a considerable distance; and its offing clear of rocks and shallows; and moreover, situated in a finer climate, would prove a kind of Scilly, to mariners.

I have not been able to obtain any proofs, on record, concerning the course of the current, *round* the Bay of Biscay. * I formerly collected some information from a French commander respecting it. He said, that the setting of the current along the coast of France, to the north and north-west, was a fact well understood; and even acted on by many, in the choice of the *tack*, on which the current gave the greatest advantage, with dead winds.

One circumstance, and that a very striking one, in respect of this particular, is, that the soundings in the Bay of Biscay show little, or no *muddy bottom* to the *southward* of the *Garonne* river; but every where to the *northward*. This seems to show that the mud of the *Garonne*, *Charante*, *Loire*, &c. &c. is all carried to the northward; and by

* Capt. W. King ascertaind the fact, in Feb. 1797.

what cause, but a northerly current? Had the motion of the sea been variable, the mud would surely have been distributed, to the south, as well as the north, of the mouth of the Garonne. The alluvial *embouchures* of the rivers in general, here, and the positions of the banks formed by them, in the sea, point to the N. or NW.; apparently the effect of the same sea current.*

IV. In continuation of this current, along the Bay of Biscay, I shall next mention, that Captain (afterwards Admiral) JOHN PAYNE assured me, that being in His Majesty's ship, Russell, in a severe gale of wind at SW., and with the ledge of rocks called the *Saintes*, not far to leeward, he was under apprehensions for the safety of the ship, during a whole night: but to his surprise found himself carried clear of the danger, by a current; which set the ship, in all, about seventy miles to the north-west.

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* From a view of the chart of soundings, between Spain and Ireland, one might be led to suppose, that the deep water and steep shore, along the north coast of Spain, had been *partly* occasioned by the water driven in from the Atlantic, in westerly storms, along that coast; and which had gradually worn away the matter *there*, and deposited it on the bank, which extends from Bayonne to the westward of Ireland. For the bank seems to expand, as it goes northward, in like manner as the current: and the water is shallower than might be expected, in proportion to the depths, farther in.

V. The flowing of the tides, on the west of Scilly, cannot well be accounted for, on any other supposition, than that the flood is prolonged by a southerly current. The flood tide is known to run nine hours to the northward; but the ebb, in the opposite direction, only three hours. This particular had not come to my knowledge, when the Paper of 1793 was written.

VI. But the most satisfactory proof, not only of the *existence* of a *northerly* current, athwart the mouths of the British and Irish channels, but also of its *velocity* (at least during certain intervals), is a statement in a book published in 1733, entitled JOSHUA KELLY's Treatise of Navigation,* (in two volumes octavo). This case is the more satisfactory, as it happened in a *dead calm* of forty-eight hours continuance: so that all uncertainty, regarding the accuracy of a *sea reckoning*, allowances for *leeway*, *drift*; &c. is precluded; since the changes of position that took place, could only have been effected by the motion of the sea, either in the nature of a *current*, or of a *tide*: and this latter must be placed out of the question, since the interval of time, included no less a space than that in which four *fluxes*, and as many *refluxes* have their periods: so that they may well be supposed to balance each other.

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* This was originally pointed out to me by Mr. JOHN PURDY, the very able hydrographer, employed by Messrs. LAWRIE and WHITTLE, Fleet-street.

" It has been observed (says Mr. KEL-" LY)* by an experienced commander, " who used the West India Voyages for " many years, from England, (in his return " from one of these) that in about the lati- " tude of 48° 30′, open with our British " channel, having a good observation (of " latitude) at the same time, it proving calm

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* Volume the first, page 434.

“ and smooth water, insomuch that he “ handed his sails, and so lay forty-eight “ hours. The first twenty-four hours at “ noon, he observed the latitude again, “ with clear weather; and found by the “ same that he had *drove to the northward* “ *twenty miles;* which made him distrust “ his former observation, though his mate “ agreed with him; because the ship had “ not gone, to his knowledge, one mile: “ and upon review, he found that he was “ not mistaken. The next twenty-four “ hours, being still calm, he had again another good observation; and then found “ himself about twenty-six miles to the “ northward of his last observation; which “ confirmed him that he was right, the day “ before; and that this must be imputed “ to a strong northern indraught, or current, there. For when you come near the “ soundings, and till you bring Ushant “ south of you, on the E.S.E. course,* *you*

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* These are *compass* bearings. The magnetic variation, at that time, being about a point and a half, westerly, these will be respectively E ½ S; NE ½ E; and ENE ½ N; true.

“ *will hardly hold your latitude*; and the ge-
“ neral course is E. N. E. or E. b. N; if but
“ a small matter to the southward of lati-
“ tude 49°. And he says, that would have
“ been my course, if we had not met this
“ opportunity of discovering this strong
“ indraught: and for want of observation
“ [i. e. if he had not known the latitude]
“ must have run up St. George’s channel,
“ or the north channel, as many have, and
“ still do, for want of the same [informa-
“ tion.]

“ After his last observation, the wind
“ sprang up; and making allowance for
“ the said indraught [i. e. in his future
“ course], the next day he was brought
“ into soundings; and the following day,
“ he was brought in sight of the *Lizard*,
“ by steering to the southward of the
“ east.*”

It will naturally occur to the reader, that although this case gives the *northing only;*

*** Meaning, no doubt, the ESE course, by compass, as above, or true E½S.**

yet that, in respect of the main question, which is, the danger of shipwreck, on Scilly; or of being carried into the Bristol Channel; it is sufficient to produce a conviction of the necessity of attending closely to the ship's course, when on the point of entering the British channel, after, or during, a course of strong westerly, or south-west winds. But it would, doubtless, have been more satisfactory, had the *direction* of the stream been known. Had that been *north-westerly*, as I have before supposed, the rate of velocity must have been more than a mile and a quarter *per* hour; or approaching to one and a half (the northing being twenty-three at a mean in the twenty-four hours): whilst that in the Atlas East Indiaman, recorded in a former Paper, was about one mile *per* hour, during four days, consecutively.

The statement in Mr. KELLY's book, which is indeed, altogether, more brief than could be wished, is also defective through the want of the distance sailed, from the place of the last observation for the latitude, to that, from whence they saw the Lizard point. They had their first soundings, the day after that observation; and on the following day, they saw the Lizard. His course appears to have been regulated with a view of preserving nearly, his parallel of 49° 16′; to which he had been carried, by the current. It is not likely that he sounded to any great depth: perhaps seventy fathoms; which in that parallel might have been about twenty leagues south-west from Scilly: and it does not appear that he considered himself in soundings, when the calm began; which however, it is probable he was, although in deep water.* Accordingly, one may conceive that his position, *at the end of the calm*, might have been about the meridian of Cape Clear, or somewhat to the eastward of it. It must be recollected, that in running towards the channel, after the calm, he had still to encounter the same adverse current: and that, possibly, to within thirty or forty miles of his seeing the Lizard.

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* Perhaps thirty to thirty-five leagues to the west of *Usbant*, and in about 100 fathoms.

But, whether his position, during the time that he was under the influence of the current, be a degree more or less, to the eastward, the fact bears the same on the main question; since a ship, in crossing the stream, wheresoever it may be situated, must have been carried out of her reckoning; and thereby placed in danger; in the event of thick weather happening subsequently, and preventing their setting themselves right, by an observation of latitude.

His idea of the eastern edge of the stream, is worth remarking; as it approaches, in a general view, to the truth. It was, that in *about* the parallel of 49°, it approached to the meridian of Ushant. And with respect to the *direction* of the stream, as he calls it a *northern indraught*, he certainly concluded that it ran to the northward, into the St. George's, or Irish channel; brushing the west side of Ushant, and the Land's End. And the effect of the current, on his ship, was no doubt, such as to warrant that belief, with those whose knowledge of the subject was confined to the mere effect of setting them to the northward of Scilly, and into the mouth of the Bristol channel.

The information contained in this statement, does not even terminate in the mere facts of the existence, and force of the current. The commander of the West India ship, is said to have made *many voyages* to, and from, that quarter; and his narrative shows him to have been *an observant man*. Yet *he* was ignorant of the existence of such a current, until the case occurred, which has been just stated. This then, alone, may serve to show, very satisfactorily, that the current does not exist in strength, but at certain intervals: and therefore operates in a more dangerous, because a treacherous manner.

Had it constantly prevailed, like that round the Cape of Good Hope, &c. it could not have escaped detection; and, in consequence, few, or no evils, would have ensued:

but these effects being only felt casually, they were considered as mere contingencies, arising from wind and weather, as in other parts of the sea; and not as resulting from a fixed cause, always operating, although in very different degrees: since no person at that time, had collected the different cases, with a view to examine, and to compare them. Some indeed, referred it to the indraught of the Bristol Channel; without considering, that if such a power existed at all, it was difficult to conceive how it could be suspended; and why it should not operate at all times.

Our navigators, in earlier times, appear to have entered the British Channel, on a more southerly parallel, than they have done in latter times. For, although they might have been ignorant of the real cause of the disturbance in their course, yet many of them believed that there was an *indraught*, as they called it, into the St. George's Channel: so that one effect of the current; that is, the *northern set*, had not passed unobserved, although the *cause* was not understood: nor, of course, could it be known, when to expect it. But I have also heard it remarked by sea officers, as long ago as I can remember, that "it was "unaccountable, what should occasion their "*running down so much distance*, in coming "in with the land, from the westward." I never heard, however, that there was any suspicion of a current, setting to the westward.

The idea of a northern *indraught* into St. George's Channel, (but which applies equally to the current west of Scilly) is clearly set forth, in a publication by Captain JOSEPH MEAD, in 1757; but which only came to my knowledge very lately, by the favour of Mr. PURDY; to whom I stand indebted, also, for the knowledge of the important fact of the *set* of forty-six miles, during the calm, in the Chops of the Channel.

Captain MEAD first relates the case of the ship Hope of Liverpool, bound from the coast of Guinea, to that port, in November 1735. (Preface, page iii.)

" Having had a good observation, by " which they found they had the Irish " Channel open, the wind continued to blow " strong from between the south and west, " but mostly from the former. Having no " other observation [of latitude] for six " days, in which time, they carried sail, " constantly, they by reckoning expected " to fall in with Cape Clear; but in the " following night, they fell in with the " *Blasquets.*" These islands and rocks are situated in lat. 52° 10′; or about forty-eight miles to the north, and one degree of longitude to the westward of Cape Clear.

Again (page 10) he says, that the Bristol merchant ships, which fall in with Cape Clear, on their homeward passage [from the West Indies, &c.] shape their course from thence, with a large wind, to the high land, near *Padstow;* which is the land they choose to make, to lead them to the entrance of the Bristol Channel. That in estimating this course, they allowed four or five degrees in the bearing, to compensate for the indraught into St. George's Channel. This angle would give about thirteen or fourteen nautic miles: and is probably what they found by experience, to be the general amount of the *northern set.*[*]

He goes on to say, that, in like manner, the safety of ships, after they come into soundings, till they reach Scilly, depended on their making *no less allowance*, than the Bristol men do, in the other Channel. For, says he, " experience informs me, that from " the commencement of soundings, in lat. " 49° 30′ N. to the length of Scilly, in *fair* " *weather*, I had found the northern in- " draught to be six or eight miles in the " twenty-four hours."

Here then, the fact of the *northern set*, is a second time recognised; though without any suspicion, any more than before, of there being a *westerly set*, also.

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[*] Although they might not have known at that day, the *true* latitude of Cape Clear, yet it may reasonably be supposed that they knew the quantity of the *difference of latitude*, between Cape Clear, and the high land of Padstow; as it was so necessary to their purpose, and so easy to be obtained.

Here it may be proper to state, what appears to me to be a very important fact; although perhaps, not connected with the current in question; but materially affecting the safety of the navigation, between the British Channel and Dublin. It was communicated to the Author, by Captain EVANS, a gentleman who superintends the harbour works at Holyhead; and who has had much experience in the navigation of the Irish sea.

All navigators, says he, in their voyage from the Land's End to Dublin, find themselves, more or less, carried to the eastward, whilst running up St. George's Channel: which is the cause of so many vessels finding themselves in Cardigan Bay; where, in tempestuous weather, and westerly winds, many have been lost. And this he justly supposes to be occasioned by a current setting to the north-eastward.

If the stream, which occasions this disturbance in the reckonings of vessels, here, be a portion of the Scilly current, it cannot well happen in any other way, than by the eastern part of that current falling on the Irish Coast, to the *east* of Cape Clear; and being thence diverted to the north-east, along the south-east coast of Ireland. This may certainly happen; and may form a part of the cause. But I conclude that the principal part of the cause, is, a current *generated* on the south-east coast of Ireland, by the prevalency of south-west and WSW. winds; to which, the position of the coast, between Cape Clear and Carnsore Point, seems particularly adapted.

This effect, from whatsoever cause it may arise, ought to be generally known; as it may produce great inconvenience and distress, to those, who for the first time make use of that navigation: and especially to such vessels, as are either not calculated, or not in a state, to beat off a *leeshore*: for the recesses of the Cardigan Bay are deep and without shelter.

It may be conceived that a current, so generated, on the south-east coast of Ireland, (and possibly augmented by a portion of the stream from the Bay), would *shoot off* to the north-eastward, pointing towards the Bay of Cardigan; as it cannot *turn short round* so acute a point, as that formed by the Cape of *Carnsore:* such being the nature of all currents, whether of water, or of air. And vessels will be carried to the north-eastward, accordingly, whilst they continue in the stream of the current. The *southerly* current which passes by Dublin, enters probably into, and merges in the stream in question; as the same kind of current, on the eastern side of England, falls into that, which passes the Strait of Dover, and afterwards runs along the Coasts of Flanders, Holland, &c.

The use of being well informed, concerning these *partial* currents, in narrow seas, is obvious: since the want of such information may, in a moment, be fatal to a ship, and her whole crew. This cannot be more strongly enforced, than by calling to mind the circumstances under which a frigate was lost, with her crew, during the war, just terminated. She sailed either from the Downs, or the Thames, to the *Helder*, and ran in the night, under full sail, on one of the shoals, lying before it. Had the Commander known that there is a general *set*, or current, from the strait of Dover (i. e. at the *back* of the Goodwin Sand), along the Coast of Flanders, Holland, Jutland, &c., and which is estimated to be equal to twenty-five miles, on an ordinary passage to the Texel, he would not have run on, during the night: or, at least, without the precaution of sounding.

Again, the Britannia India ship, in 1809, was lost on the *back* of the Goodwin Sand; probably through ignorance of the *acceleration* of the same current, during a violent gale at west, or south-west. A pilot would be reckoned deficient, who did not know the direction and force of the several streams of tide, at all seasons, within his province. There is a current generally, if not constantly, running up the British Channel; that is, the eastern tides are the strongest; and in stormy weather from the west, *run longer* than the western, (or ebb) tides. At the same time the level of the channel is raised two feet or more, above that of the North Sea; and consequently, the former will discharge plentifully into the latter. Here then, is an *acceleration* of the current; and which men who have the charge of piloting of ships, ought to have known. And who can be ignorant of the high level of the Channel, when they know that the ports in the Channel, are some feet deeper in strong westerly winds, than at ordinary times?

Although the following remarks do not apply to the *Scilly*, or *Thwart* current, yet as relating to currents, that at all times affect the navigation around the British Islands; it is hoped that the utility of inserting them, may atone for their being out of place.

It is proper to state, that the facts here set forth, are assumed, on the ground of *detached* notices, and not from a connected chain of observations; which could hardly have been expected. And it is also proper to be stated, that the currents here intended, only form a portion of the ordinary stream of tide, along the coast. And it is the *difference* between the degrees of velocity of the opposite streams, on the same coast, that constitutes the current in question: as indeed, it cannot be manifested, in any other way. An instance has just been given in the British Channel.

Where rivers form any quantity of alluvial ground, at their entrance into the sea, there, most infallibly, the direction of the *sea current* will be shown, by the arrangement of the alluvial ground; or by the sand or mud banks contiguous to it, in the sea. The process is explained in a note: and those, to whom I may not have rendered myself intelligible, may easily satisfy themselves, by observing the junction of any two streams, that are very much disproportioned to each other, in point of bulk;

and in which, no art has been employed to counteract the natural course of things.*

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* The point of junction of two rivers (or of a river with the sea, provided that the sea has a predominant stream of current) will always form an *acute angle*, if the soil, through which they run, be not of a texture, firm enough to resist the corroding power of the stream; but composed of alluvial matter, deposited by one, or both of the waters; as is ordinarily the case. This point of junction, may be either *firm alluvial land*, or a *bank* of *sand or mud*, under water; as the case may happen. And finally, the acute angle of junction will always point in the direction of the stream of the *recipient* water; be it a river, or the sea.

The reason of this is, that two streams, at their confluence, have a natural tendency to *slide* into each other, as the easiest mode of effecting their junction; and were they, either by reason of the natural solidity of their banks, or by artificial means, compelled to join at right angles, or at a very large angle, the meeting of their waters, in a case where they had any degree of rapidity, would produce an agitation, that would prove injurious to their banks, and inconvenient to the navigation.

For the sake of illustration, let it be supposed that a small river is conducted artificially, into a larger one (or into a sea which has a current along shore,) through a *cut* made through the alluvial soil; and the angle of junction to be very large, or approaching to a right angle; and without any artificial aid, to keep it in that state; the following train of consequences would ensue: (It is to be supposed, of course, that the recipient river had its bed previously enlarged, to receive the other, in order to prevent floods).

The first effect would be, that the head of the *adjunct* river, entering with an almost perpendicular course, into that of the *recipient*, would meet with so much resistance from it, that it would be partly beaten back, and compelled to seek

In effect, the *embouchures* of rivers, situated in alluvial ground, always *point in the direc-*

its way along the bank of the recipient river. This bend in its course, would induce such a pressure on the bank, at the *lower* angle of junction, as would soon wear it away; and an *oblique course* of approach, of the whole body of the adjunct stream, would commence. In the mean time, *a triangular space* of *still water,* would be formed between the *original* upper angle of junction, and the *new* one, occasioned by the obliquity of course: and this *still water,* as is its nature, would let drop the mud and sand which it had held suspended, whilst in motion; and thus begin to form *a triangular bank,* of the same shape and extent.*

Here then the operation is commenced, in all its parts: and the *triangular bank* by its being constantly on the increase, will force the adjunct stream to borrow still more and more, on its opposite bank; which will gradually wear away, until the *angle of junction* of the two waters, becomes so acute, that the adjunct stream no longer meets with any resistance, from that of the recipient; but may be said to *slide* into *contact* with it. This then, is the *natural state* of the junction of streams: but after all, the point of junction will, although almost imperceptibly, move downwards; because the *triangular bank* must continue to receive additions, if left to itself. Mean time, the body of it rises by the continual depositions, above the surface of the water, and becomes firm alluvial land; its *apex* being the point of junction of the two waters; and its *direction,* of course, the same with that of the stream of the recipient water.

When two streams that are nearly equal to each other, in respect of bulk, and of velocity, join; each of them, as it were, asserts *its own rights*; and the collective stream takes

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* The reader is referred, for explanation, to the sketch on the following page.

tion of the stream of the sea current. The sand, mud, or gravel banks formed by the

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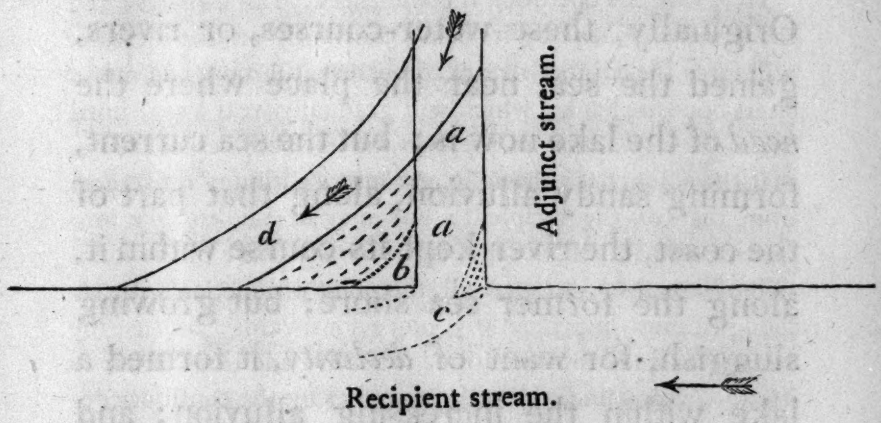
a direction, which is generally a mean, between those of the two streams, whilst they remained in a separate state. And in like manner, the falling in of a stream that bears any proportion to the recipient river, will occasion a proportionate determination of the collective stream, towards the line of the former course of the adjunct.

It will be recollected, that all that was meant to be said here, applies to the courses of streams, through alluvial ground: and also to such, as have some degree of velocity.



(*a*) Artificial cut, through alluvial ground.

(*b*) The angle of the bank first worn away.

(*c*) The commencement of a triangular bank formed by the *still water* above the point of junction.

(*d*) Progress of the adjunct stream, towards a more permanent junction.

same current, *lie in the same direction;* and with their *narrowest*, or *sharpest* point, downwards.

In many places along the coast, water courses are found to terminate in long narrow lakes, with narrow sandy tracts, between them and the sea (through which the water still oozes, though all appears to be *stagnant*). These also have been formed by the sea currents, and point the same way. Originally, these water-courses, or rivers, gained the sea, near the place where the *head* of the lake now is; but the sea current, forming sandy alluvion, along that part of the coast, the river kept its course within it, along the former sea shore; but growing sluggish, for want of *declivity*, it formed a lake within the increasing alluvion; and occasionally, in time of floods, forced open again, a communication with the sea. These lakes equally prove a sea current, as well as its line of direction.

If the reader requires examples, on a large scale, the mouths of the *Senegal* and *Missi-*

ſippi rivers, may be referred to. In both caſes the currents are well known. And for leſſer ones the rivers on the coaſts of our own Iſlands; as thoſe of *Chriſt-church*, *Shoreham*, *Newhaven*, *Orford*, *Yarmouth*, *Dublin*, &c. The ſmall water-courſes prove, equally with the large ones, the ſtate of the current.

It is aſſumed, on the ground of various notices that the author has collected, that along the weſtern ſide of Ireland, occaſioned by the prevalence of weſterly winds, the preponderance of the ſtream is northwards:* that it turns round the north end of the Iſland (or at leaſt, a part of it does,) and thence ſouthward, along the eaſtern coaſt: probably the whole way to Carnſore Point; but certainly paſt Dublin. The effect of a ſoutherly current, or prevailing ſoutherly tide, over the northern, is viſible in the preſent *outfall* of the Liffey; and ſtill more in the traces of the former one; previous to the erection of the *long wall*: both having an inclination to the south. And possibly, the *direction* of the wall has itself occasioned a part of the present difficulty, arising on the matter of the pilotage.

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* Articles of various kinds, known to have come from the ſouthward, and ſouth-eaſt, are continually caſting up in Galway Bay.

And here I beg leave once more to quote Captain Mead; who, speaking from his own experience, says (page 11), "on the western Coast of Ireland, off the *Shellocks* "(qu. Skelligs?) the *northern indraught*, "was not less than four leagues in twenty-four hours, even in *moderate* gales. Also, "off the western coast of *Lewis* Island, I "find it stronger than in *soundings*, [that is, "more than six or eight miles in the "twenty-four hours]; and also, off *Foul* "Island, (Shetland) something weaker "than the latter."

Along the south-eastern coast, from the Mizen head, and Cape Clear, to Carnsore Point, the Author is less informed, in respect of notices from others, than concerning any other part of the Coast; but having visited it repeatedly, and considered all the circumstances belonging to it, he is firmly persuaded that there is a *north-easterly* current; and that it is *this* stream, prolonged from Carnsore Point, that carries vessels to the eastward of their course, in their way up the Irish Sea. (See above, page 57.)

The same kind of northerly stream, and occasioned, probably, by the same cause, is produced on the western coast of Scotland; from whence it turns round the north end of the island, and thence southward, along its eastern side, as far as Harwich; where it falls into the strait of Dover, or Channel Current, which comes up at the back of the Goodwin Sand.

The Channel Current has already been mentioned (page 61.) and can hardly be questioned, as to its existence, when the circumstances already set forth, are considered: such as the *elevation* of the *level* of the Channel, at times, by two feet or more; the *longer continuance* of the *eastern* stream of tide, than the *western;* together with the stream that runs to the north-east, from the Strait of Dover, along the whole Coast of Flanders, Holland, and Jutland: and which, affording, as is said, a help of twenty-five miles, ordinarily, between the Thames and the Texel, a run of only 160 miles, or less; cannot but be referred in part, to the Channel, or Dover Current. (For more particulars concerning the current at the Strait of Dover, &c. the reader is referred to Vol. XVIIth. New Series, of the Society's Transactions.)

At the mouth of the Baltic sea, the Jutland current is joined by the *outfall* of the former; which, at all times, receives more water than it can evaporate. The collective stream then proceeds along the coast of Norway; continuing its northerly course. Off the *Naze*, has been known to run two miles *per* hour.

Such is the general course of the stream of current, around these Islands. There are, however, many particular exceptions to be made; as happens in the case of tides, where a deep recess in the coast often disturbs the uniformity of the general course of the stream.

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